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April 6, 1995

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William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW
Washington, DC 20554

RECEIVED
APR 7 1995
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

Re: ET Docket No. 94-124, RM-8308;
CC Docket No. 92-297, RM-7872, RM-7722
Ex Parte Presentation

Dear Mr. Caton:

On April 6, representatives of Hughes Communications Galaxy, Inc. ("Hughes") met with a Commission representative to discuss matters related to the Commission's pending proceedings in CC Docket No. 92-297 and ET Docket No. 94-124. The Hughes representatives included Edward J. Fitzpatrick, Vice President of Hughes, Nicholas W. Allard and the undersigned, each of Latham & Watkins and counsel for Hughes. The Commission was represented by Regina Keeney.

The enclosed materials formed the basis for the discussions. In addition, our discussions included issues presented by proposals to auction the 28 GHz band.

An original and two copies of this letter are enclosed. Copies of this letter are being provided simultaneously to the Commission representative identified above.

Respectfully submitted,

John P. Janka

Enclosures

HUGHES

PRESENTATION TO

FEDERAL COMMUNICATIONS COMMISSION

28 GHz CONFLICTS AND SOLUTIONS

HUGHES COMMUNICATIONS GALAXY INC.

April 6, 1995

SUMMARY

- 28 GHz band was globally allocated in 1971 for satellite services
- Advanced technology now allows breakthrough interactive, wideband satellite services
- We need this spectrum to make these global satellite services universally available to the public
- LMDS at 28 GHz will significantly inhibit this new technology and create conflicts with global use of this band for satellite services
- LMDS is technically and economically feasible in other bands

28 GHZ BAND IS ESSENTIAL TO THE NII/GII

- Worldwide satellite allocation enables global systems
  - -- supports NII/GII goals
  - -- supports export of satellite technology
- 28 GHz band needed to relieve current congestion at C and Ku bands
  - -- demand for spectrum is demonstrated by the numerous satellite proposals for the band
  - -- NASA ACTS system is a $1 billion precursor to commercial use of the band
- 2.5 GHz of bandwidth provides the capacity needed for tomorrow's high data rate applications
- 28 GHz band satellites can provide immediate nationwide/global infrastructure
  - -- allow access to wideband services in areas that terrestrial systems do not reach
  - -- distance insensitivity makes service to rural areas economical

28 GHZ BAND CANNOT ACCOMMODATE ALL USES UNDER CURRENTLY PROPOSED REGULATORY STRUCTURE

- Analog LMDS service (2 GHz)

- Various satellite services

  GSO FSS (2.5 GHz)

  Non-GSO FSS (1.3 GHz)

  Non-GSO MSS feeder links (300-500 GHz)

28 GHZ SATELLITE SERVICES AND PROPOSED ANALOG LMDS SERVICE AT 28 GHZ ARE NOT BOTH FEASIBLE

- Ubiquitous satellite and LMDS terminals are incompatible at 28 GHz

  -- Confirmed by conclusions of Negotiated Rulemaking

- No technical solution proposed that allows co-frequency, co-coverage sharing

- Prior coordination impractical with widespread deployment of terminals by each service to same types of users

NON-GSO MSS FEEDER LINKS CAN BE ACCOMMODATED BELOW 17.7 GHZ

- sufficient bandwidth can be made available in these bands
- "reverse band working" in these bands is most efficient way to accommodate non-GSO MSS absent the adoption of criteria for sharing with GSO
- technically feasible
- issue being addressed at WRC-95

AUTHORIZING LMDS AT 40 GHZ ALLOWS EACH OF LMDS AND SATELLITES TO HAVE FULL ACCESS TO 2 GHZ OF SPECTRUM

- LMDS works at 40 GHz

  -- LMDS is technically and operationally feasible at 40 GHz

  -- Equipment manufacturers confirm this
     Philips
     Dudley Labs
     Endgate Technology
     Lincoln Labs (MIT)

  -- European experience confirms the feasibility of 40 GHz
     · equipment production is imminent

  -- 2 GHz of spectrum allows either an analog or a digital LMDS system to be accommodated

  -- LMDS system configuration need not change

AUTHORIZING LMDS AT 40 GHZ ALLOWS EACH OF LMDS AND SATELLITES TO HAVE FULL ACCESS TO 2 GHZ OF SPECTRUM

- LMDS costs are comparable at 40 GHz
  - -- neither 40 GHz nor 28 GHz equipment is in full production
  - -- initial slight increase in 40 GHz equipment cost will disappear as full production develops
- LMDS views 40 GHz as its "expansion" band
- the single US LMDS licensee can be accommodated at 40 GHz
  - -- transfer tentative award of pioneer preference
  - -- require 28 GHz satellite licensee(s) in New York to bear relocation costs

COMMERCIAL SATELLITE SYSTEMS ARE NOT TECHNICALLY OR ECONOMICALLY FEASIBLE AT 40 GHZ

- worldwide spectrum allocation does not exist at 40 GHz
- rain problem at 40 GHz is significantly worse for satellites
- existence of military systems at 44 GHz is irrelevant
  - -- specialized military transmitters do not offer the performance needed for commercial wide bandwidth services
    - · data rates and power levels are well below what is needed for commercial broadband service
  - -- costs are prohibitive for commercial applications

SEGMENTING THE 28 GHZ BAND DOES NOT SOLVE CURRENT CONFLICT

- provides insufficient spectrum for all proposed Ka band services

  -- non-GSO satellite services could be required to share the spectrum with GSO satellite services

     · preliminary Hughes analysis suggests that GSO/non-GSO sharing is possible with adoption of certain criteria

  -- Analog LMDS spectrum needs could be significantly reduced through use of digital modulation

- cannot analyze full impact of segmentation because full range of proposals for the Ka band is not yet known

SUPPORTING INFORMATION

HUGHES

TECHNICAL FEASIBILITY OF LMDS AT 41 GHz

TECHNICAL FEASIBILITY OF THE 41 GHZ BAND FOR LMDS

TOPICS

- ❑ **FACTORS AFFECTING CELL SIZE AND AVAILABILITY**
  - **SYSTEM COMPONENT PERFORMANCE**
  - **RAIN LOSSES**
  - **NON LINE-OF-SITE OPERATION**
  - **FOLIAGE ATTENUATION**
  - **RAIN BACKSCATTER**
- ❑ **LMDS FREQUENCY REQUIREMENTS AT 41 GHz**

SYSTEM COMPONENTS IN THE 41 GHz BAND

- ❒ TRANSMITTER POWER
  - 80 WATT TWTA CAN BE PROVIDED BY MULTIPLE VENDORS
  - 100 WATTS AVAILABLE WITH NRE

- ❒ TRANSMITTER ANTENNA
  - IMPROVED PERFORMANCE OVER 28 GHz FOR SAME SIZE
  - ~3 dB INCREASE IN GAIN
  - NO REDUCTION IN PERFORMANCE TO CLOSE-IN SUBSCRIBERS

SYSTEM COMPONENTS (CONTINUED)

- ❒ RECEIVER ANTENNA
  - IMPROVED PERFORMANCE OVER 28 GHz FOR SAME SIZE
  - ~3 dB INCREASE IN GAIN
  - REDUCED BEAMWIDTH (~4^0 TO ~3^0) IS A BENEFIT
    - REDUCTION IN MULTIPATH INTERFERENCE
    - IMPROVED FREQUENCY REUSE

- ❒ RECEIVER NOISE FIGURE
  - 6 dB NOISE FIGURE AVAILABLE (SAME AS AT 28 GHz)

SYSTEM COMPONENTS FOR THE 41 GHz BAND ARE AVAILABLE AND THEIR PERFORMANCE ALLOWS LMDS SYSTEMS WITH CELL SIZES COMPARABLE TO THOSE REQUIRED AT 28 GHz.

RAIN LOSSES

- A 41 GHz LMDS SYSTEM, OPERATING WITH THE SAME CELL SIZE, SAME TRANSMIT POWER, AND SAME ANTENNA SIZES, WILL ACHIEVE COMPARABLE PERFORMANCE WITH A 28 GHz LMDS SYSTEM
  - REGION D2 (NEW YORK)
    - @ 28 GHz: 3 MI. CELL, 99.9% AVAILABILITY [BASELINE]
    - @ 41 GHz: 3 MI. CELL, 99.84%
  - REGION D3 (N CAROLINA, TENNESSEE REGION)
    - @ 28 GHz: 2 MI. CELL REQUIRED FOR 99.9%
    - @ 41 GHz: 2 MI. CELL GIVES 99.84%
  - REGION E (FLORIDA REGION)
    - @ 28 GHz: 1.2 MI. CELL REQUIRED FOR 99.9%
    - @ 41 GHz: 1.2 MI. CELL GIVES 99.86%
  - ALL OTHER REGIONS IN U.S. (D1, B1, B2, F, C) WILL PROVIDE BETTER AVAILABILITY THAN D2 (LOWER RAIN DISTRIBUTIONS)

NOTE: RAIN LOSSES DETERMINED FROM CRANE GLOBAL MODEL, ITU-R COEFFICIENTS, FOR WORST CASE HORIZONTAL VERTICAL POLARIZATION

RAIN LOSSES (CONTINUED)

- FOR D2 REGION, @41 GHz, WITH 3 MI CELL, OVER 80% OF SUBSCRIBERS IN ALL CELLS WILL EXCEED 99.9% AVAILABILITY. REASONS:
  - RAIN LOSSES FOR VERTICALLY POLARIZED CELLS (50% OF SUBSCRIBERS), ARE LOWER BY 0.6 dB/MI @ 28 GHz AND 0.9 dB/MI @ 41 GHz
  - ONLY SUBSCRIBERS IN OUTER EDGE OF HORIZONTALLY POLARIZED CELLS WILL SUFFER REDUCED AVAILABILITY
    - FOR 3 MILE CELL @ 41 GHz, SUBSCRIBERS WITHIN 2.4 MI OF HUB (62%) WILL OPERATE WITH 99.9% OR BETTER AVAILABILITY

RAIN LOSSES CAN BE MANAGED AT EITHER FREQUENCY, AND COMPARABLE PERFORMANCE CAN BE ACHIEVED AT 41 GHz FOR SIMILAR CELL SIZES ANYWHERE IN THE UNITED STATES

NON LINE-OF-SITE OPERATION

- ❒ NON LINE-OF-SITE(LOS) OPERATION WILL BE POSSIBLE FOR A VERY SMALL NUMBER OF SUBSCRIBERS AT EITHER FREQUENCY
- ❒ DIFFERENCES IN CHARACTERISTICS OF NON LOS PROPAGATION AT 28 GHz AND 41 GHz ARE INCONSEQUENTIAL
  - REFLECTION - EXPERIMENTAL DATA AND ANALYSES DEMONSTRATES LESS THAN 20% DIFFERENCE
  - DIFFRACTION - PRECISE CALCULATIONS USING TWO DIFFERENT TECHNIQUES SHOW ONLY 2 dB DIFFERENCE, BUT WITH SIGNAL LEVELS SO LOW IN EITHER BAND AS TO BE USELESS FOR LMDS
  - SCATTERING - BUILDING SCATTER MEASUREMENTS AND PRECISE CALCULATIONS VERIFY VERY SMALL 'SHADOW' REGIONS WITH VERY LOW USABLE SCATTERED POWER AT EITHER FREQUENCY

VIABLE NON LINE-OF-SITE OPERATION WILL BE MINIMAL AT EITHER FREQUENCY. IT IS NOT A FACTOR IN THE SELECTION OF OPERATING FREQUENCY

FOLIAGE ATTENUATION

- MEASURED DATA IN THE RANGE 9.6 TO 57.6 GHz CLEARLY SHOWS THAT FOLIAGE LOSSES FOR TREES IN LEAF INCREASE SLOWLY FROM 28 GHz TO 41 GHz, WITH THE ADDITIONAL LOSS AMOUNTING TO A 'SMALL CORRECTION ONLY'

- OTHER MEASUREMENTS SHOW NEARLY INDISTINGUISHABLE DIFFERENCES FOR LEAFY TREES BETWEEN THE TWO FREQUENCY BANDS

- MAJOR POINT - PROPAGATION THROUGH FOILAGE AT EITHER FREQUENCY WILL BE LARGE - AS HIGH AS 30 dB FOR A SINGLE TREE

PROPAGATION THROUGH FOLIAGE SHOULD BE AVOIDED AT <u>EITHER</u> FREQUENCY. IT IS NOT A FACTOR IN THE SELECTION OF OPERATING FREQUENCY.

RAIN BACKSCATTER

- PRIOR CLAIMS THAT RAIN BACKSCATTER INCREASES WITH THE FREQUENCY CHANGE FROM 28 TO 41 GHz IS COMPLETELY INCORRECT! JUST THE OPPOSITE OCCURS!
- CONCLUSIVE RESULTS, USING MIE SCATTERING THEORY, AND VERIFIED WITH RADAR BACKSCATTER MEASUREMENTS, SHOW THAT THE BACKSCATTER ENERGY DROPS WITH INCREASING FREQUENCY (DECREASING WAVELENGTH)!

RAIN BACKSCATTER AT 41 GHz WILL BE LOWER THAN AT 28 GHz. THIS WILL REDUCE THE POTENTIAL FOR BACKSCATTER INTERFERENCE INTO SUBSCRIBER ANTENNAS AND PROVIDE BETTER FREQUENCY REUSE AT 41 GHz.

LMDS SPECTRUM REQUIREMENTS AT 41 GHz

- Frequencies can reused in adjacent cells at 41 GHz just as at 28 GHz: antenna designers and manufacturers confirm that sidelobe levels and cross-polar discrimination need not be adversely affected at the higher frequency.
- In a well-designed 41 GHz receiver, no additional spectrum is required to compensate for local oscillator instability or increased phase noise.
- Channel bandwidth and spacing at 41 GHz can be the same as at 28 GHz. The 29-MHz spacing between co-polarized TV channels in the UK analog MVDS frequency plan did not result from the choice of 41 GHz for LMDS; it was driven by a desire to use widely-available ASTRA DBS receivers.

A 41 GHz LMDS system requires no more spectrum than a 28 GHz system.

SUMMARY

- 41 GHZ COMPONENT PERFORMANCE IS COMPARABLE TO 28 GHz, AND VENDORS CAN OFFER PRODUCTS AT COMPETITIVE COSTS.
- RAIN LOSSES ARE MANAGEABLE AT EITHER FREQUENCY, AND COMPARABLE LINK AVAILABILITY CAN BE ACHIEVED.
- NON LINE-OF-SIGHT OPERATION, FOLIAGE ATTENUATION, AND RAIN BACKSCATTER ARE NOT FACTORS IN THE SELECTION OF OPERATING FREQUENCY.
- A 41 GHz LMDS SYSTEM REQUIRES NO MORE SPECTRUM THAN A 28 GHz SYSTEM.

DETAILED AND COMPLETE TECHNICAL ANALYSES, ALONG WITH VERIFICATION FROM MEASUREMENTS, HAVE CONCLUSIVELY DEMONSTRATED THAT 41 GHz LMDS IS FEASIBLE WITH THE SAME CELL SIZE AND WITH COMPARABLE PERFORMANCE AND COSTS AS 28 GHz LMDS, FOR ANYWHERE IN THE UNITED STATES.

SUPPORTING CHARTS

Comparison of NYC with Miami

- At 99.9% and 28.5 GHz

NYC:	14.5 mm/hr	=>	4.2 dB/mi,	2.6 dB/km
Miami:	35 mm/hr	=>	10.5 dB/mi,	6.5 dB/km
Geographical Difference :			6.3 dB/mi,	3.9 dB/km

- At 99.84% and 41.5 GHz

NYC:	11.1 mm/hr	=>	5.6 dB/mi,	3.5 dB/km
Miami:	25.5 mm/hr	=>	12.2 dB/mi,	7.6 dB/km
Geographical Difference :			6.6 dB/mi,	4.1 dB/km

- Conclusion: LMDS will be forced to resolve geographical differences at 28.5 GHz; the geographical differences at 41.5 GHz are of comparable level